Portulaca oleracea L. in the era of globalisation: a species of great nutraceutical value

Veronica Mantovani
Nicola Volpi

Department of Life Sciences, University of Modena and Reggio Emilia, ITALY

Fabrizio Buldrini
Giovanna Bosi

Department of Life Sciences, University of Modena and Reggio Emilia, ITALY

Ethnobotany of purslane (*Portulaca oleracea* L.) in Italy and morphobiometric analyses of seeds from archaeological sites in the Emilia Romagna Region (Northern Italy)

Giovanna BOSI [1], Paolo Maria GUARRERA [2], Rossella RINALDI [1] and Marta BANDINI MAZZANTI [1]
[1] *Department of Palaeobiology and the Botanic Garden Museum, University of Modena and Reggio Emilia*
[2] *National Museum of Folk Traditions, Rome*

Portulaca oleracea L. is a common ruderal, synanthropic, cosmopolitan taxon, highly polymorphic, typical of warm sites (Danin and Raus, 2012; Danin et al., 2014; Danin et al., 2016). In Italy its status as a native species is doubtful (Pignatti, 1982). It is well known since the antiquity for its medicinal and nutrient qualities (Bosi et al., 2009): all parts of the plant have therapeutic properties (Gastaldo, 1987). It has been used for a long time as an analgesic, anti-inflammatory, antipyretic, diuretic, emollient, lenitive and anaphrodisiac. Many of such properties have been recently confirmed; furthermore, *P. oleracea* is very rich in omega-3 polyunsaturated fatty acids (Ezekwe et al., 1999), so that its use is recommended to contrast the excess of fatty acids assumed by fast foods (Picchi and Pieroni, 2005) and its seeds are good to counteract diabetes mellitus (El-Sayed, 2011).

Purslane from Durante (1585) (Botanica Garden of Modena)

Wild (left) and cultivated (right) purslane from Mattioli (1568) (Botanical Garden of Modena)

Fruit of *P. oleracea* with seeds

Archaeological seeds of *P. oleracea* from Parma (10th - 11th cent. AD - L med: 1 mm)

site		layer	dating (cent. AD)	sample
1	Modena - ex Cassa di Risparmio	trench/30/31	1st	11
2	Modena - Novi Sad - vasca circolare	215	1st-2nd	\
3	Classe - condotto idrico	well 3 north - sample 75	2nd-7th	\
4	Modena - Palazzo Vaccari	9	5th-6th	10
5	Modena - San Francesco	8	10th-11th	\
6	Modena - Palazzo Solmi	9 and ?	10th-11th	\
7	Parma - Piazza Garibaldi	165	10th-11th	5.1
8a	Ferrara - Corso Porta Reno-via Vaspergolo	2645	11th	1.4
8b	Ferrara - Corso Porta Reno-via Vaspergolo	2640	11th	1.5
8c	Ferrara - Corso Porta Reno-via Vaspergolo	2659	11th	1.6
8d	Ferrara - Corso Porta Reno-via Vaspergolo	2395	11th-12th	1.7
8e	Ferrara - Corso Porta Reno-via Vaspergolo	2122	11th-12th	1.8
9	Modena - Vescovado	17	12th-13th	8
10a	Argenta - via Vinarola-Aleotti	2.2	13th-14th	4.2
10b	Argenta - via Vinarola-Aleotti	2.3	13th-14th	4.3
10c	Argenta - via Vinarola-Aleotti	8.1	13th-14th	4.4
8f	Ferrara - Corso Porta Reno-via Vaspergolo	828	14th-15th	1.10
8g	Ferrara - Corso Porta Reno-via Vaspergolo	1095	14th-15th	1.12
11	Ferrara - Piazza Municipale	1050	15th	2
12	Lugo - Piazza Baracca	593	15th	6

P. oleracea's seeds from Roman period (1st century AD) to Renaissance (15th century AD)

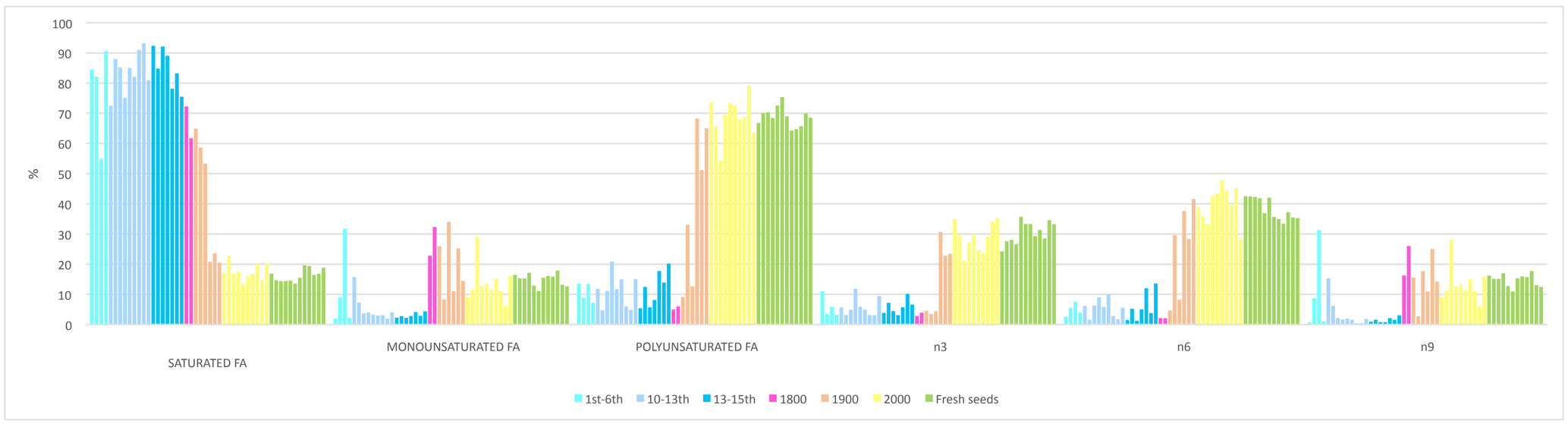
P. oleracea's seeds from Herbaria (from year 1862 to year 2011)

Ceva, Broglio (CN) - TO	1862	198	A
Tempio, S. Teresa di Gallura (SS) - TO	1881	196	B
Losine (BS) - PAV	1917	189	C
Torrente Bisagno, Genova - SIENA	1920	138	D
Bosco degli Arrighini, Orzinuovi (BS) - PAV	1976	184	E
Gressan, Gargantua (AO) - AO	1992	126	F
Selva di Castelfidardo (AN) - CAME	1998	147	G
Lago di Burano, Capalbio (GR) - SIENA	1999	136	H
Valleremita, Fabriano (AN) - CAME	2001	146	I
Salorno (BZ) - BOZ	2004	168	J
Alpreid, S. Pancrazio (BZ) - BOZ	2005	167	K
Terlano (BZ) - BOZ	2005	169	L
Malles (BZ) - BOZ	2005	172	M
Laimburg, Ora (BZ) - BOZ	2005	182	N
Pardell, Chiusa (BZ) - BOZ	2007	171	O
Caldaro (BZ) - BOZ	2008	166	P
Tires (BZ) - BOZ	2009	180	Q
Pian di Rocca, Castiglione della Pescaia (GR) - SIENA	2011	132	R
Herbaria - AO - Museo Regionale di Scienze Naturali della Valle d'Aosta (Saint-Pierre); BOZ - Museo di Scienze Naturali dell'Alto Adige (Bolzano); CAME - Università di Camerino; PAV - Università di Pavia; SIENA - Università di Siena; TO - Università di Torino.	year (of harvest)	sample	

In this work we tested the content of fatty acids in seeds from Roman period to present, as a comparison to the content of fatty acids of the aerial parts of the plant: 12 fresh plant and seeds samples, collected in Summer 2015, 18 seeds samples coming from Italian herbaria, dating from 1862 to 2011, and 20 seeds samples coming from archaeological excavations, dated from 1st to 15th cent. AD. Total lipids were extracted according to a modified method of Folch et al. (1957) and methyl esters were analyzed by gas chromatography (GC)-FID.

We found a high content of polyunsaturated fatty acids in fresh plants and seeds. Moreover, a quite similar profile with comparable saturated, monounsaturated and polyunsaturated fatty acids was observed in both seeds and aerial parts of the plant, even if significant differences were measured in singular fatty acid percentages. Furthermore, comparing seeds samples from different historical periods, we determined an evident decrease in polyunsaturated fatty acids depending on increasing time, from ~69% of fresh seeds up to ~11% in archaeological samples with the consequent increase in saturated fatty acids. This is probably due to a degradation process, caused by atmospheric oxygen exposition and unsaturated fatty acids oxidation during time. The applied reported methodology would be useful for the determination of fatty acids content and profile also in ancient samples of seeds and parts of plants.

Fatty acids (FA) composition (%) of *P. oleracea*'s seeds from Roman period to present. Fatty acid are reported as saturated, monounsaturated, polyunsaturated, unsaturated omega 3 (n3), unsaturated omega 6 (n6) and unsaturated omega 9 (n9).



Comparison of fatty acid (FA) composition (%), between fresh aerial part (L) and seed (S) of *P. oleracea*. Fatty acid are reported as saturated, monounsaturated, polyunsaturated, unsaturated omega 3 (n3), unsaturated omega 6 (n6) and unsaturated omega 9 (n9)

Examples of chromatograms obtained from *P. oleracea*'s seeds analysis; chromatogram from archeological seed (left); chromatogram from fresh seeds (right)

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